Eigenanalysis - Tensor Fields

Direction, invariant under transformation A, sought:

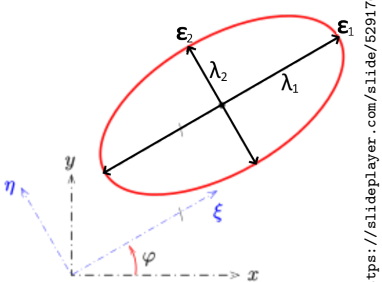
Eigenvalue Problem

$$A \cdot \epsilon = \lambda \epsilon$$

with: A: square matrix, λ: eigenvalue ϵ: eigenvector

- eigensystems:
  full set of eigenvalues and -vectors
- we propose to use singular value systems (SVS)
  in analogy to Eigensystems

Proof: "Glyphs for General Second-Order 2D and 3D Tensors", Gerrits et al., 2017



Eigensystem: characteristic ellipsoid

Source: https://slideplayer.com/slide/5291764

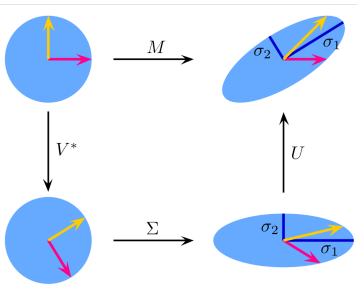
Computation of Eigensystem - Tensor Fields

Matrix Decompositions

1) Eigenvalue Decomposition: $A = RSR^*$
2) Singular Value Decomposition (SVD): $A = U\Sigma V^*$

1. eigenvalues and eigenvectors
2. singular values and singular vectors (SVs)

- SVs represent the axes of characteristic ellipsoid [1]
- singular values ($s_i = \sqrt{|\lambda_i|})^2$ are lengths of axes



Singular value system

Source: https://w.wiki/6WN

[1] Gerrits et al. "Glyphs for General Second-Order 2D and 3D Tensors", IEEE Transactions on Visualization and Computer Graphics, 2017.

[2] M. Kieburg, "What is the Relation between Eigenvalues & Singular Values?, 2016